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MAINTAINING THE FUNCTIONALITY OF THE COAL SETTLING BASIN AT THE UNDERWATER PIT KOVIN

Abstract

Underwater coal exploitation is carried out by the use of underwater excavator "Kovin I". The mined coal is transported through a pump system as a hydro mixture via the pipeline Ø900 mm to the facility for irrigation and classification of the mined coal. From this facility, the undersieve goes to the coal settling basin, where in the area of over 32 ha the complete sediment settling is done. Considering that the material durability is limited, this paper presents a way to empty, i.e. maintain the coal settling basin.

Keywords: coal, underwater exploitation, settling tank, Kovin

INTRODUCTION

Exploitation of mineral ore in the coal mine Kovin began in the second half of 1991. Work began with the excavation of overburden (sand, gravel and clay), and since 1995 the coal exploitation has begun. All mineral ore are excavated under water by an underwater dredge and deposited on the island Dubovačka ada through a pipeline system. The settling tank of coal and other under sieve sediments made during the coal exploitation is one of the base infrastructure objects in the Kovin mine. Its function is to take and settle the under sieve fractions of coal and other sediments that are a product of the underwater excavation method and coal classification. The settling tank was designed in the original variant of underwater mine operation as an integral part of the coal depot from which it was separated by a dividing mound and connected by overflow pipes. Its function was to direct the excavated coal hydraulically directly in the depot, and to settle the sludge and water created by decantation from the overflow pipes.

By giving up on discharging of the excavated coal without previous technological equipment and construction the facility for taking and coal classification in 1995, the role and function of settling tank have, besides its surface of 32 hectares, changed. The present role of settling tank is to take in, select and drain small granulations (-5+0 mm) created as the under sieve fractions from the hydro mixture of coal, sand and clay during coal exploitation. This paper presents a method of emptying the settling tanks. After an analysis of deposited material in settling tanks that was conducted in the period from November 2013 to February 2014, the settling tanks were divided into zones. This paper presents the solution for material exclusion for the purpose of maintaining the functionality of the settling tanks. This solution should define the possibilities of regular settling tank maintenance. Technical solution of partial settling tank discharge creates the possibility of further mine operations and taking in the new under sieve

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sediments. This method of settling tank discharge increases the basin utilization, and more positive financial effects are achieved through it.

TECHNOLOGICAL EXCAVATION PROCESS OF MINERAL ORE IN THE COAL MINE KOVIN

Overburden Excavation

Overburden excavation is done by the underwater dredges. Sediments (sludge, sand, gravel and clay) which go 22 m deep are excavated by the underwater bucket dredge, and the excavated material is laded and transported to a location designated by the project. The sediments that are at a greater depth are excavated by an ejector reffiler "Kovin I", and transport is done through pipelines and deposited in already prepared cassettes.

Coal Excavation

Coal exploitation is done exclusively by the underwater – ejector reffiler "Kovin I". The excavated coal is exclusively transported by the dredge through its pumps as a hydro-mixture through a pipeline Ø900mm to the primary dewatering and classification facility.

The basic characteristics of the "Kovin I" dredge are:

- cutting wheel diameter (4.5 m.);
- maximum excavation depth (45.0 m);
- installed power (11,3 MW);
- pylon stepping (4.5 m);
- speed of circular motion (0-20 m/min).

The guaranteed hourly dredge capacities, given by the manufacturer are:

- sand (2,300 m³/h);
- gravel (1.300 m³);
- coal (600 t/h).

Dewatering and Coal Classification

The primary dewatering and coal classification facility (EHS III) is a part of the

basic exploitation system, and connected to the pipeline via the "Kovin I" dredge, so that it presents a unique technological-production whole. Dewatering and classification of trench coal hydro-mixture is done in the facility, and commercial assortments are provided:

- piece-cube, i.e. "Marl piece" of the class size -300+30 mm;
- nut, class size -30+15 mm;
- bean, size class -15+5 mm;
- under sieve product (-5 (7) + 0.0 mm), which represents the mixture of small coal, clay, sand and water.

The commercial product makes up to 57 % of entry mass (trench coal), while the rest is made up of the under sieve product 31 % and excavation losses 12%.

Additional Coal Refining Facility "Kučuk Plant"

This facility refines (the under sieve product), mixture of coal and tailings from the EHS-III facility. The average annual capacity of this facility is 40 t/h on entry, i.e. up to 20 t/h of the final product. The coal refinement facility in technological terms presents a facility for gravity concentration in a hydro-cyclone with a heavy environment. The maker of this equipment is the "Kučuk Makina", a company from Turkey. The material is brought via trucks from the settling tank and unloaded into a bunker of around 20 m³ in volume. The bunker is covered by a grid with openings 400×400 mm in order to prevent insertion of pieces that are larger than 400 mm into the process. The bunker is emptied through a belt feeder which brings the coal onto a vibro-feeder. The class of +100 mm presents the tailings (clay pieces) which are taken in by a conveyor belt and deposited on depot.

Settling Tank Function

Settling tank is a hydro-construction facility where the under sieve product of the process of primary dewatering and classifi-

cation is deposited for the purpose of deposition (settling) the solid stage and water overflow into the Danube through five overflow pipes. The hydro-mixture enters the settling tank in its western part, and clear water flows over in the east part of settling tank. The settling tank was originally designed and constructed as an integral system of the coal depot from which it is separated by a divider mound and connected with overflow pipes. Its function was to dewater the excavated coal that is hydraulically directly deposited in the depot, and settles the sludge and water made by dewatering from the overflow pipes. By giving up on discharging the excavated coal without previous technological equipment and construction the facility for taking and coal classification in 1995, the role and function of settling tank were, besides its surface of 32 hectares, changed. The present role of the settling tank is to take in, select and drain small granulations (-5+0 mm) created as the under sieve fractions

from the hydro mixture of coal, sand and clay during coal exploitation. The constructed depot was retrofitted and serves to take in and deposit the produced coal classes.

Current Settling Tank Condition

The settling tank is a facility in which the under sieve product of dewatering and classifying process for the purpose of deposition (settling) of the solid stage and water overflow in the Danube through five overflow pipes is deposited. The hydro-mixture enters the settling tank in its west part, and clear water overflows at the east part of the settling tank. The settling tank can be divided in the following zones, shown in Figure 1, and characteristics are given in Table 1.

For the purpose of maintenance the settling tank, it is necessary to obtain the following mechanization: dragline dredge, trench excavator, loader, bulldozer, tipper and a grader.

Table 1 *Characteristics of individual settling tank zones*

Wet part of settling tank	Active part of settling tank	Zone 1	Drainage canal. The materials with a high sand content whose abrasion negatively impacts the refining facility. The material from this zone is treated as tailings.
		Zone 2	Canals in the settling tank. The zone from which the material refined in the Kucuk Makina is excluded
	Unavailable part of settling tank	Zone 3	The zone in the immediate extension of drainage canals. With the existing mechanization material exclusion is impossible.
		Zone 4	The zone between the canals and overflow pipes. The materials inaccessible to the existing mining mechanization. Zone covered with cane.
		Zone 5	Zone between the canals and overflow pipes. Material inaccessible to the existing mining mechanization. Zone covered with cane and weed.
		Zone 6	Zone of water mirror
		Zone 7	Zone in which the material from EHS and overflow from the new settling tank is indirectly settled
	New part of settling tank	Zone 8	Part of the new settling tank with a great sand content. The material is treated as definite tailings.
		Zone 9	Part of the settling tank from which coal dust is taken and sold.
		Zone 10	Zone of the new settling tank with a high clay content - inaccessible part, covered in cane. Currently treated as waste.
	Dry part of settling tank	Zone 11	Location in which the materials, which will be refined during the year, is temporarily deposited.

Figure 1 *Settling tank with zoned locations*

SEPARATION AND MATERIAL TRANSPORT FROM SETTLING TANK

This paper presents the operation technology of the excavation transporting mechanization at the separation of settled sediments in the settling tank area, in zones 5, 6 and 7. Material excavation from the settling tanks consists out of three stages.

First stage: *Excavation via spoon dredge with truck transport*

In this stage the hydraulic spoon dredge on the mound excavates the material from settling tank in full width and unloads it onto trucks. The material is deposited in a specially prepared area – the cassette.

Figure 2 First stage of separation and material transport

Second stage: Dragline and spoon dredge excavation with loading onto trucks

In the second stage when the spoon dredge and trucks are removed, the dragline dredge goes into operation with digging range is 25 m. The dragline also operates from the mound of settling tank and transports the material from the full width into the already excavated area that was excavated by the spoon dredge in the first stage. The material is deposited along the internal slope of settling tank mound. The dragline is used up to the level of +70 m. The material that the dragline has transferred at the internal slope of the settling tank as addi-

tionally excavated by a trench dredge and loads it onto trucks for material transport to the designated location.

In the second stage, the material from the settling tanks is excavated in width of 25 m. The construction of auxiliary mounds (combs) within the settling tank was planned made up of sturdy materials 25 m in length and 5 m wide at the crown. These auxiliary mounds are constructed in parallel between the second and third stage. The distance between the auxiliary mounds is 40 m.

Figure 3 Second stage of material separation and transport.

Third stage: Dragline excavation from the auxiliary mound and spoon dredge operation with loading onto trucks

In the third stage, the dragline goes to the auxiliary mounds and in full width (25 m) transfers the material from settling tank to the internal slope of the same into

the reach of the spoon dredge. The spoon dredge does additional excavations and loading onto trucks using standard technology.

Figure 4 Third stage of separation and material transport

CONCLUSION

The process of cleaning the settling tank is technologically demanding. The mine possesses the mechanization, apart from the dragline dredge, that can regularly maintain the settling tank's functionality. This displays only one of the settling tank discharge methods that needs to constantly be in operation. By discharging this area of the big settling tank, the operation of the facilities for additional coal processing is enabled. Exclusion of materials from the big settling tank and discharging the same gives positive financial effects, as well as greater basin utilization. The significance of the big settling tank is great in environmental term because clean water pours out of it.

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